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1. RESEARCH ROUND-UP

1.1 INDIGENOUS DRUGS

The maiden number of the NBG Newsletter had indicated brief reviews of the work done by NBG in different Areas of Work would be given in future issues. The first of these reviews of the pharmacognostic studies made by the NBG scientists on INDIGENOUS DRUGS, a subject gradually being developed as an area of thrust, is given below:

Even though modern medicine is widespread in India, majority of the country's population still depends on crude drugs for the alleviation of their sufferings. India is probably the only country in the world where the two ancient 'Ayurvedic' and 'Unani' systems of medicine, commonly referred to as indigenous systems, still survive and flourish, side by side with the allopathic and homoeopathic systems. The materia medica of the two former systems include a rich store of very useful drugs of vegetable origin.

These drugs are important and widely used not only in India but, also in foreign countries, such as, USA, where, according to a survey made some years ago, as many as 47% of the 300 million new prescriptions written every year contained one or more drugs of natural origin and the number of such prescriptions increased by 7.7% over a period of ten years. Besides, many of the well-known allopathic formulations also included these drugs.

Although many drugs of the indigenous systems of medicine enjoy a high repute, few of them are scientifically standardized. Besides adulteration, the true botanical identity of the ingredients of many of the well known 'Ayurvedic' and 'Unani' preparations is also not known. The descriptions of the individual drug plants in the 'Ayurvedic' and 'Unani' texts are not only vague, but, at times, quite fanciful and misleading. Because of this, several

species of plants, sometimes widely different, are believed to be the sources of one single drug. For instance, the name 'Punarnava' is applied to three species of Boerhaavia and two of Trianthema; 'Bhrangraj' is represented by at least three different plants, and 'Pashanbhed' by as many as thirteen species. The name 'Somlata', which is known from the time of the Rigveda, is given to six or seven different species of plants; 'Rohitak' is referred to Tecomella undulata, Amoora rohituka and Erythrina variegata var. orientalis· 'Kurchi' to Hollarrhena antidysenterica, Wrightia tomentosa and W. tinctoria; 'Bala' to Hibiscus tiliaceous, Sida acuta, S. rhombifolia, S. spinosa and S. veronicaefolia, etc., etc. To make matters worse, different parts of a plant body are sold as one single drug.

Correct botanical identification and standardization of these drugs is, therefore, of great importance. Equally important is the standardization of agro-techniques for commercial cultivation of these drug plants which have maximum annual turn-over and are of wild origin or are imported. The NBG has, therefore, been making, for some years, investigations on indigenous drug plants which are briefly reviewed below:

Pharmacognostic studies have been made on 40 species of the family Apocynaceae, which yields several important indigenous drugs like 'Indrajau', 'Sarpagandha', 'Gule-cheen', 'Chandni', 'Karveer', etc., and criteria laid down for identifying the respective drugs from commercial samples. Similarly, the drug 'Gaozaban', which has been referred to three different genera, viz., Onosma, Anchusa and Echium, has actually been found to be composed of nutlets of Anchusa strigosa and flowers of Echium amoenum. About a dozen species of the Indian polygonums have also been studied.

Work on various plants that go under the name of 'Mamiran' has been taken up and one of these has been found to be active against gram positive bacteria, especially, the

penicillin resistant ones. This finding is very important as the gram positive bacteria are the main flora of the human conjunctivitis.

Some other indigenous drugs that have been worked out are 'Sirish', 'Vidang', 'Varun', 'Arka', 'Plaksha', 'Jivanti', 'Paundarik', 'Kaktundi', 'Gandarayan', 'Amargandhi', 'Kamraj', 'Palankya' and 'Mehndi'. All the plants referred to 'Pashanbhed', 'Pathar Phor', 'Pathar Chatta', and names with similar connotations, have been identified.

Other plants that have been similarly worked out are Withania somnifera ('Ashwagandha'), Corallocarpus epigaeus ('Mirchakand'), Nerium indicum ('Kaner'), Asparagus acerosus ('Shatavari'), Solanum khasianum, Dioscorea spp., Matricaria chamomilla ('Babuna'), Andrographis paniculata ('Kalmegh') and Cannabis sativa ('Vijaya').

In order to provide information with regard to availability of various drugs in different regions of the country and their proper utilization, distribution of some 13 seed and fruit drugs has already been published. Likewise, lists of various drug plants found in Karimnagar district of Andhra Pradesh, Moral Kanda (H.P.), the Dronagiri Hills, Badrinath area and Kumaon Hills have also been compiled. Drug plants of Chakrata area (Dehra Dun) are being studied.

About 1500 plant samples have been screened for various constituents like alkaloids, saponins and flavonoids, resulting in the discovery of 113 new sources of saponins, 261 of flavonoids and 233 of alkaloids.

Cultural practices for a few drug plants, like, Tylophora indica ('Antamool'), Anethum graveolens (Dill), Apium graveolens, etc., have also been worked out.

In order to help practitioners, drug manufacturers and dealers to recognise the genuine drug and also to preserve the

germ-plasm of national drug wealth, the need to build up a living collection of the indigenous drug plants has been keenly felt and a Herbal Garden is being set-up at NBG. All the drug plants that can grow at Lucknow are being planted here. However, there are many more that require a temperate climate for proper growth and completion of their life-cycle. Hence, such a garden may also be set-up in any of the temperate regions of the country.

Alongwith the above, the NBG has taken up the work of organising a permanent museum of indigenous drugs as a complement of the Herbal Garden. Drug samples from various markets in the country are being procured. This, it is hoped, will help sort out the confusion that prevails in the drug market today due to lack of knowledge about the genuine drugs.

Recognising the expertise available in the field of indigenous drugs at NBG and the work done here, the Indian Council of Medical Research and the Central Council of Research in Indian Medicine and Homoeopathy (CCRIMH) have been successively running, for the last nine years, a Composite Drug Research Scheme at NBG and a part of the work reported in this resume has been done in collaboration with the CCRIMH.

1.2 BOTANICAL EXPEDITION TO MADMAHESHWAR-II

As a follow-up of the last year's Joint Botanical Expedition to Madmaheshwar in Uttarakhand Hills of Uttar Pradesh, another Joint Botanical Expedition explored the Tung Nath and the adjoining areas, besides resurveying the Madmaheshwar region, during September-October, this year. The members of this second expedition were:

1. Dr. P. D. Dogra, Scientist, NBG
2. Mr. Ajay Singh, " "
3. Dr. Prakash Chandra, " " (Leader)
4. Dr. Mohinder Pal, " "

5. Mr. K. M. Balapure, Scientist, NBG
6. Mr. B. P. Dimri, " CIMPO
7. Mr. T. K. Sharma, Photographer, NBG
8. Mr. Murari Ranjan, Plant Collector, NBG
9. Mr. Ram Pher, " " "
10. Mr. Ram Adharey, Plant Propagator, NBG

In the first phase, the Expedition made an extensive collection of plant materials from the Madmaheshwar area and, in the second phase, explored the Tung Nath region, trekking from Guptakashi, via Okhimath, Duggalbitta and Chopta. The expedition went up to Chandrashila, the highest place (3750 m.) in the area where Jurinea macrocephala (Dhoop plant) was found growing in abundance.

The expedition made a thorough survey of the medicinal plants, like, Orchis latifolia, Aconitum heterophylla, Artemesia sp., Allium wallichi and Gaultheria trichophylla, growing there. In addition, germ-plasm of a number of indigenous plants of potential ornamental value, like, Hypericum cernuum, Arundinaria falconeri, Polygonum affine, Fritillaria roylei, Rosa sericea, Geranium nepalense, Chirita pumila and Hedychium spicatum, was collected. Nearly 350 herbarium specimens were made with detailed field notes.

About 10 samples of mature berries of Solanum khasianum, growing wild, were collected from different localities (920 - 1525 m. above sea level) for estimation of their solasodine content. A general survey of Dioscorea spp. growing in Madmaheshwar as well as Tung Nath areas was also made.

Some of the important crops of the area, viz., Eleusine, Setaria, Echinochloa and Amaranthus, were closely studied and a good amount of germ-plasm representing the variations within these four crops was collected.

An additional study made this time was a general survey of the forest structure of Madmaheshwar and Tung Nath areas. The forests were found dominated by the four species of Quercus — Q. glauca, Q. incana, Q. dilatata, and Q. semecarpifolia. Pinus wallichiana, the blue pine, which otherwise has a continuous distribution from Kumaun to Nepal, except in the moist zone of Central Himalayas, east of the river Pindar, was conspicuous by its absence.

In addition to the flowering plants, the expedition also made a rich haul of lichens (nearly 450 samples) and ferns (nearly 200 specimens).

The expedition, which had left for Madmaheshwar on September 9, 1975, returned to Lucknow on October 3, 1975.

1.3 PROLONGING SHELF-LIFE OF GLADIOLUS

Since some studies made at the Department of Botany, Delhi University, for prolonging the shelf-life of cut-flowers of chrysanthemum and lupine with the help of certain chemicals had met with success, the NBG and the Department of Botany of the Delhi University have taken up a collaborative research work on prolonging the shelf-life of cut gladiolus species, which are supplied regularly by the NBG as and when required for this purpose by the Delhi University.

1.4 'BIRBAL SAHNI' — A NEW CHRYSANTHEMUM CULTIVAR

Species	:	Chrysanthemum morifolium
Class	:	Small flowered (Decorative Pompon)
Cultivar	:	'BIRBAL SAHNI'

'Birbal Sahni', a new cultivar of chrysanthemum, has been developed by the NBG as a selection from the seedlings of 'Nanako', a small-flowered Japanese cultivar, bearing golden yellow Pompon type of blooms, which was introduced in

the NBG in 1972. 'Nanako' is a favourite among the chrysanthemum lovers of Japan for its compact, perfectly Pompon blooms, borne on sturdy erect stems and its very long vase life.

The new cultivar, 'Birbal Sahni', bears snow-white, Decorative Pompon blooms which are at their best during the second half of November at Lucknow, and are suitable both for flower arrangement and garland making. These are larger (5 cms across) in size than those of 'Nanako' (3 cms across). The new cultivar retains the parental characters of sturdy erect stems and long vase life. It throws suckers in a large number and its cuttings root quickly. It is hardy enough to tide over the rainy season with a low mortality rate.

In view of its snow-white colour and the coincidence of its blooming with the birthday (November 14) of the late Prof. Birbal Sahni, FRS, it has been considered fit to name the new cultivar after him, as a token of high esteem and regard in which he is held at NBG.

1.5 ORNAMENTAL FOLIAGE AMARANTHS

The ornamental foliage amaranths, cultivars of Amaranthus tricolor, though highly decorative on account of their attractive multi-coloured foliage and blooming during the 'lean' summer months, have failed to find an important position in ornamental horticulture due to the absence of homozygosity and the consequent uneven and unpredictable performance. Added to it is their sensitivity to photoperiod and temperature, resulting in their failure to give optimum growth under different agro-climatic conditions. The NBG has developed five cultivars of garden amaranths, two of which merit special mention. Of these, one has green foliage lower down while the top is crowned with golden yellow leaves, and the other is an autotetraploid, which, besides being hardier and dwarfer, has deeper coloured broad foliage than its diploid. All the five cultivars are true breeding and uniform

and develop colouration within a period of one and a half months, when sown during the first week of June at Lucknow.

1.6 POLLEN-SPORE TEACHING AID KIT

External morphological features of pollen grains and spores are so characteristic of their respective species that they can be an important tool in studies in the taxonomy and evolution of plants. In order to familiarise teachers and students of graduate and post-graduate classes with the fundamental principles of pollen-spore morphology, a Pollen-Spore Teaching Aid Kit has been prepared by the NBG. The kit contains 20 pollen and 2 fern spore slides of the following taxa:

(A) POLLEN GRAINS: Acacia melanoxylon, Amaranthus dubius, Canna indica, Cannabis indica, Citrus medica, Delonix regia, Eriocaulon cristatum, Hemerocallis fulva, Ipomoea carnea, Luffa cylindrica, Mimosa pudica, Ocimum sanctum, Oenothera lamarkiana, Pinus merkusii, Portulaca grandiflora, Psidium guajava, Tectona grandis, Vernonia cinerea, Vigna sinensis and Zea mays.

(B) FERN SPORES: Microsorium diversifolium and Onychium bicidum.

These pollen-spore slides illustrate various morphological types, pertaining to the different categories of characters, namely, aperture, exine ornamentation, exine strata, size and shape, and are accompanied by an attractive booklet which gives descriptions of the slides and information on various related topics. The pollen slides and the booklet are contained in a plastic vallet. The kit, to be made available shortly, will be sold at a no profit, no loss basis.

2. PUBLICATION

2.1 A NEW BULLETIN ON CHRYSANTHEMUM

Coinciding with the Annual Chrysanthemum and Coleus Show, held on December 6 and 7, 1975, the NBG also brought out their new Bulletin on Chrysanthemum.

Way back in 1956, the NBG had published a bulletin on Chrysanthemum, written by the late Mr. S. Percy-Lancaster, a well-known horticulturist of his time. That bulletin went out of stock some years ago and since then, the NBG had, time and again, been approached to bring out a revised and enlarged edition, including the entire course-work of its training course.

The new Bulletin embodies much of the accumulated experience of cultivation of chrysanthemum in the East and such up-to-date scientific discoveries of the West as are relevant to the Indian conditions. Besides describing some of the R and D work carried out on this flower at NBG, it gives an illustrated account of different types of blooms and scientific as well as aesthetic aspects of chrysanthemum culture and recommends for adoption of new techniques that save time and labour.

In the words of Dr. B. P. Pal, FRS, former Director-General, ICAR and President, INSA, this Bulletin "is full of practical information and should be a great boon to growers of Chrysanthemum".

Mr. M. A. Kher, the author of this edition, is a scientist at NBG and has been working on chrysanthemum for the last several years, two of which were spent in Japan.

3. PH.D. DEGREES AND THESES

3.1 PH.D. DEGREES

3.1.1 "Palynological Studies of some Vegetable Crops": Agra University, Agra. -- Mrs. Surinder Kapoor.

3.1.2 "Pollen Morphological Studies of Brassica and Linum"; Kanpur University, Kanpur. — Mr. R. K. Sharma.

3.2 THESES SUBMITTED

3.2.1 "Investigations on Seed Sterility in Morus species (Mulberry)"; Kanpur University, Kanpur. — Mr. B. L. Srivastava.

3.2.2 "Physiology of Citrus Virus Complex": Kanpur University, Kanpur. — Mr. A. K. Verma.

4. LECTURE AND SEMINARS

4.1 LECTURE

4.1.1 "Mycoplasma" — Dr. S. P. Raychaudhury, Head, Plant Pathology and Mycology Division, Indian Agricultural Research Institute, New Delhi ... Nov. 22, 1975

4.2 DEPARTMENTAL SEMINARS

4.2.1 "Use of Ionizing Radiation for the Production of New Cultivars of Chrysanthemum" — Dr. M. M. Gupta ... Oct.30 & 31, 1975

4.2.2 "Some Aspects in Mushroom Cultivation" — Mr. M. S. Singh ... ... Dec. 20, 1975

5. PLANTS EXHIBITION AND FLOWER SHOWS

5.1 HOUSE PLANTS EXHIBITION

The NBG organised its first ever House Plants Exhibition on October 4 and 5, 1975, with a view to familiarising the garden lovers as well as the common man with the rich variety of innumerable foliage plants available for regular interior and exterior decoration, social and religious events and general greenery, during an otherwise lean period of summer months in the northern India. The exhibition was inaugurated by Prof. K. N. Kaul, Vice-Chancellor, Chandra Sekhar Azad University

of Agriculture and Technology, Kanpur. Among the 1125 cultivars on display at the exhibition, there were beautiful specimens of crotons, coleuses, ferns, aralias, aglaonemas, alocasias, eranthemums, marantas, cacti and succulents, September-October blooming chrysanthemums, sansevieras and a host of other plants, good for cultivation indoors, under full or partial shade and at places which receive only a limited amount of sunlight and so are specially suitable for window and verandah gardens, tray or dish gardens, etc.

5.2 CHRYSANTHEMUM AND COLEUS SHOW

The Annual Chrysanthemum and Coleus Show, one of the biggest flower shows of its type in the country and marking the advent of the winter season flowers in North India, was organised on December 6 and 7, 1975. The Show was formally opened by Prof. T. S. Sadasivan, Consultant to CSIR for its plant-based laboratories, who, in his inaugural speech, underscored the usefulness of such shows and their appropriateness as an integral part of the NBG's activities. Floriculture, Prof. Sadasivan maintained, must be one of NBG's main concerns.

This year, the show attracted 161 competitors who entered 1358 entries in all. The quality of blooms had a definite edge over that of the last year's exhibits. Three hundred and eleven prizes, besides three running cups, were given away to the successful competitors at a colourful prize distribution function, held on December 7, 1975 and presided over by Lt. Gen. J.S. Nakai, GOC-in-C, Central Command, Lucknow.

As at the last show, the NBG exhibited some of its research work on chrysanthemum, viz., production of virus-free chrysanthemum by tissue culture, control and eradication of aspermy virus of chrysanthemum by heat treatment, "training" and grafting of chrysanthemum, etc.

5.3 CHRYSANTHEMUM SHOW, NEW DELHI

For the first time, the NBG participated in the New Delhi Chrysanthemum Show on December 5 and 6, 1975, at the invitation of the organisers who requested NBG to display named varieties of chrysanthemum. Accordingly, the NBG exhibited 88 named varieties, 48 large-and 40 small-flowered chrysanthemums. The exhibited flowers were grouped as suitable for (i) exhibition, (ii) cut flowers and (iii) garlands. The new bulletin on chrysanthemum, brought out recently by NBG and the distinctive floral greeting cards were also displayed there.

6. WELFARE ACTIVITIES

The Welfare Committee, NBG, has organised the following:

6.1 CONSUMER CO-OPERATIVE SOCIETY

The National Botanic Gardens Employees' Consumer Co-operative Society Limited, Lucknow, a duly registered body which was set up in October last, started operating a co-operative store w.e.f. December 22, 1975. It is also proposed to operate a Co-operative Credit Scheme shortly for the benefit of the needy members of staff.

6.2 NBG CANTEEN

The NBG had all along been without a canteen of any sort and the members of staff had, perforce, to depend on road-side tea-stalls. With the opening of a canteen on the premises, a long-standing need has been fulfilled and has been most welcome.

6.3 WELFARE FUND

A Welfare Fund has been started from November. 1975. The members subscribe 50 paise per head per month, and the

subscription is deducted at source. This fund has been created with a view to render financial assistance to members of staff and their families in cases of sudden death, serious and prolonged illness or other pecuniary circumstances.

7. PERSONALIA

7.1 TRANSFER

1. Mr. P. N. Malhotra, Accounts Officer, joined NBG vice Mr. M. P. Gupta, Accounts Officer, transferred from NBG to CDRI w.e.f. December 1, 1975.

7.2 POSTED OUT

1. Dr. T. Raja Rao, Scientist, left NBG on November 1, 1975 to take up his new assignment at the Indian Institute of Horticultural Research, Bangalore.
2. Dr. P. D. Dogra, Scientist, left NBG on December 31, 1975 to take up his new assignment as Silviculturist, Central Arid Zone Research Institute, Jodhpur.

7.3 LEAVE PREPARATORY TO RETIREMENT

1. Dr. G. C. Mitra, Scientist, proceeded on leave preparatory to retirement on October 3, 1975.

7.4 DISTINGUISHED VISITORS

1. Dr. Hari Narain, Director, National Geophysical Research Institute, Hyderabad ... Oct. 28, 1975
2. Mr. A. J. Kidwai, Ex-Secretary, Department of Science and Technology, Government of India, New Delhi ... ... Nov. 5, 1975
3. Dr. M. L. Sahare, Chairman, Agricultural Scientists' Recruitment Board, ICAR, New Delhi Nov. 11, 1975

4. Dr. Harsh Vardhan, Director, Central Scientific Instruments Organisation, Chandigarh — Nov. 14, 1975

5. Three Vice-Chancellors of U.P. Universities ... ... — Nov. 15, 1975

6. Prof. S. J. Dimitrov, a Bulgarian Scientist ... ... — Nov. 17, 1975

7. Brig. A. Nilkantan, Commandant, AMC Centre & School, Lucknow ... ... — Nov. 21, 1975

8. Prof. S. Nurul Hasan, Minister of State for Education, Government of India, New Delhi ... — Nov. 22, 1975

9. Lt. Gen. J. S. Nakai, GOC-in-C, Central Command, Lucknow ... ... — Dec. 7, 1975

10. Lt. Gen. Krishna Rao, Maj. Gen. K. Sundary, Maj. Gen. M. L. Chibber, Brig. A. J. M. Homji and Brig. H. S. B. Grevar ... ... — Dec. 11, 1975

11. Dr. Dinesh Mohan, Director, Central Building Research Institute, Roorkee ... ... — Dec. 12, 1975

12. Mr. K. G. Krishnamurthi, Chief (Administration), Council of Scientific and Industrial Research, New Delhi ... ... — Dec. 25, 1975

8. FORTHCOMING EVENTS

8.1 Annual Rose & Gladiolus Show will be organised on January 17 and 18, 1976.

8.2 The NBG will be one of the organisers of the Symposium on "The Development of Essential Oils in Uttar Pradesh", to be held at Harcourt Butler Technological Institute, Kanpur, on January 17 and 18, 1976; Ramganga Command Development Authority and the Essential Oil Association of India, Kanpur are the other organisers of the Symposium.

8.3 The first Bougainvillea Festival will be held during the third week of March, 1976.

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1. RESEARCH ROUND-UP

1.1 INDIGENOUS PERFUMES

Perfumes comprise all adoriferous materials, natural or synthetic, which possess an agreeable odour. These include essential oils, floral and other perfume extracts, perfumed aqueous distillates, synthetic perfume blends, etc. Natural flower perfumes and essential oils occupy a dominating position in the perfumery trade, because these are indispensable even for the synthetic blends of the popular perfumes. These are used in very high class blended perfumes, cosmetics and toilet preparations and are very costly. India imported essential oils and perfume concentrates worth Rs.2.68 crores and exported some essential oils and perfume preparations, such as, hair oils, perfumed aqueous distillates, etc., worth Rs.9.94 crores during the year 1974-75. In view of the vast export potentiality of these products, the NBG has been running a research project on flower perfumes, flavouring materials and essential oils of commercial importance. A brief resume of the work which also includes cultural, technical and chemical studies, is given below:

1.1.1 Cultural Studies

A number of indigenous as well as exotic essential oil-bearing and aromatic plants, raised successfully on saline-alkaline soils, having pH 8.5-10.0, of the Banthra Research Station, were: Anethum graveolens (Dil), Cymbopogon flexuosus (Lemongrass), C. nardus (Citronella Ceylon), C. winterianus (Citronella Java), Jasminum grandiflorum ('Chameli'); thirteen species of Eucalyptus, viz., E. camaldulensis, E. crebra, E. gomphocephala, E. leucoxylon, E. melanophloia, E. microtheca, E. morrissi, E. odorata, E. populnea E. robusta, E. saligna, E. tessellaris and E. torelliana, Matricaria chamomilla (German Chamomile), Mentha arvensis (Japanese mint), M. spicata (spearmint), Ocimum kilimandscharicum, Origanum majorana, Pimpinella anisum (Aniseed), Polianthes tuberosa (Tuberose) and

Rosa damascena (Chaiti Gulab). The yields of their buds/flowers and of their essential oils were recorded and the results found encouraging.

1.1.2 Technical Studies

1.1.2.1 A Process and Field Distillation Unit for Rose Oil Distillation: Indian Patent No.117510: Rose oil occupies a dominating position among the natural perfume materials and is used in a large quantity in high class perfume preparations and cosmetics. Major supplies of this oil come into world market from Bulgaria, the Bulgarian rose oil being considered to be of the best quality and selling at the maximum price of about $3000/kg. Now-a-days, USSR, France, Germany and Turkey are also producing rose oil. In India, mainly rose 'attar' (rose perfume dissolved in sandalwood oil) and rose water are produced. Rose oil is not produced on commercial scale owing to low yield and high cost of labour for distillation. Besides, the cultivation of roses is also not sufficient enough for rose oil production. The major part of rose flower crop is used for the preparation of rose water which sells @ Rs.5-10 per litre, depending on its quality.

Rose oil is obtained by water distillation of the flowers of Rosa damascena, a commercial variety of scented roses, but, the yield is very low, varying from 0.01 to 0.02 per cent. The process and field distillation unit, developed by the National Botanic Gardens, gives 0.03 per cent yield of the oil (by weight) by distillation of Rosa damascena flowers. The NBG's process is very simple and the labour for distillation has also been considerably reduced. The oil thus obtained resembles the Bulgarian rose oil in all respects as shown by comparative examination of both the samples by olfactory tests and gas liquid and thin layer chromatography.

The oil has also been got evaluated by Messrs. Fritchze Brothers INC., New York (USA), an international concern dealing in essential oils which declared it as good as the Turkish rose oil.

Rose water, having a pleasant and fine aroma and equal to the weight of flowers distilled, is obtained as a by-product which can be sold in local market at a fairly good price to fetch additional income.

The Field Unit for the extraction of rose oil is small, handy and portable one, made of 20 guage copper sheet and having a capacity to charge 40-50 kg flowers in one lot. It costs about Rs.4000-5000 a piece.

1.1.2.2 Preparation of Attars and Perfumed Oils from Flowers: Indian Patent No.124082: Some flowers, such as, Jasminum spp., Polyanthes tuberosa, Narcissus spp., Cestrum nocturnum, Lawsonia alba, Nyctanthes arbortristis, Mimusops elengi, Gardenia spp., etc., continue to give out perfume for a long time after plucking, till they fade and wither. A technique has been developed by which the perfume from flowers is taken in a current of air which is then bubbled through a solvent. The odour accompanying the air is retained in the solvent. The process is continued till the flowers fade and wither.

Attars from Jasminum grandiflorum, Lawsonia alba, Nyctanthus arbortristis, Mimusops elengi and Polyanthes tuberosa flowers have been prepared with this technique and products having the true odour of the flowers obtained.

1.1.2.3 A Distillation Apparatus for Attar and Perfumed Water: Indian Patent No.130396: This is a simple apparatus designed for the small scale preparation of attars and perfumed waters. The novel feature of this apparatus is that all the vapours get fully condensed in the condenser and the water-jacketted receiver,

yielding oil and perfumed water of a quality superior to that obtained by using ordinary equipment.

The main draw-back of the conventional ('Deg' type) technique, extensively used for water distillation of flowers and seeds, is the overheating of the plant material, leading to deterioration of the quality of the resultant products. The condensation of the perfumed vapours is rather faulty and there is always some loss due to leakage. Separation of oil from the perfumed water is also a major difficulty.

All these draw-backs have been eliminated in the new apparatus designed by the NBG. It is so constructed as to make the separation of oil and collection of the perfumed water automatic. Its double cooling system allows complete condensation of vapours and the quality of the products obtained is much superior.

Especially suited for small-scale manufacturers of 'attar' and perfumed water, this handy device can be made of glass, copper or stainless steel.

1.1.3 Chemical Studies

1.1.3.1 An yield of 0.25 per cent concrete has been obtained on solvent extraction of the flowers of Jasminum grandiflorum, a commercial scented variety of jasmine, raised on saline-alkaline soils. The physico-chemical properties of the concrete corresponded to the concrete of Grasse (French) origin which fetches the maximum price in the world market.

1.1.3.2 Origanum majorana (syn., Majorana hortensis) raised on the saline-alkaline soils of the Banthra Research Station and hydro-distilled has given 1.9 per cent of an essential oil on dry weight basis. The oil contains α-terpinene 7.9 per cent, p-cymene 15 per cent, α-terpineol 19.4 per cent, geraniol 7.9 per cent, citronellol 2.8 per cent, linalool 1.5 per cent and

carvacrol 12 per cent.

1.1.3.3 The physico-chemical properties of the essential oils from Cymbopogon flexuosus (lemongrass), C. nardus (Citronella Ceylon), C. winterianus (Citronella Java), Mentha spicata (spearmint) and Mentha arvensis (Japanese mint), raised on the saline alkaline soils, have been found to correspond to the National and International specifications for these oils.

1.1.3.4 Studies have also been conducted on the determination of optimum harvesting time of certain essential oil bearing crops cultivated at Lucknow. Studies have been completed in the case of Mentha spicata (spearmint) for which the optimum harvesting time determined is from 2nd to 3rd week of May. During this period, the crop has been found to contain the maximum concentration of the oil. Physico-chemical properties of the oil correspond to the British Pharmacopeal Codex specifications for spearmint oil.

1.1.3.5 An yield of 0.7% of oil (W/W on fresh wt. basis) has been obtained by steam distillation of Ocimum kilimandscharicum raised on saline-alkaline soils. The oil has been found to contain 61.7% camphor, out of which 45% was isolated by simple chilling and filteration. The properties of the camphor obtained have been found to be identical to the National and International standard specifications for camphor.

1.1.3.6 Menthol (peppermint) isolated from the oil of Mentha arvensis grown indigenously has been examined for its physico-chemical properties, vis-a-vis those of the menthol of Japanese origin (Buddha brand). The comparison has also been done by column and thin layer chromatography. Both the menthols have been found to be identical.

1.1.3.7 0.5% (V/w) of essential oil has been obtained by the distillation of the leaves of Psidium guajava L. cv. 'Safeda', collected during the months of October-November, the leaf sheding period for guava tree. The essential oil which is used as a

flavouring agent in food industry has been found to contain myracene 0.99%, dl-limonene 8.01%, caryophyllene 7.7%, caryophyllene oxide 37.5%, eugenol 13.0% and 1, 8 cineole 2.7%.

1.2 PLANTS OF RAMAYANA

Ramayana, one of the two great epics of India, is a work of great antiquity, attributed to the illustrious sage Valmiki. While the exact period of writing Ramayana is a debatable matter, this great epic has long been studied from religious, social, political, geographical, literary and cultural points of view. But the aspect which has not received much attention is the scientific one as the Ramayana contains many terms, expressions and passages pertaining to such scientific subjects as botanical, zoological, architectural, meteorological and archaeological. The Ramayana mentions a large number of plants and the names of trees, shrubs and climbers and tubers and fruits are scattered throughout its text. The NBG, therefore, took up a study on determining the botanical identity of the plants mentioned in the Ramayana. Consequently, a list of 234 plant names, mentioned in the 'Ramayana' by Valmiki as well as in 'Ramcharitamanas' by Tulsidas, has been prepared, giving their Latin equivalents, vernacular names, botanical descriptions, uses and distribution. The relevant sanskrit 'slokas' and Hindi verses in the two Ramayanas, along with their translation in simple Hindi, have also been included.

This study is to serve as a basis for the larger study of the vegetation of the North and Eastern India of the Epic period, its comparison with the present day vegetation of the same regions and the evolutionary and ecological changes which the former has undergone over the years since the epic was first written.

1.3 COLLABORATIVE WORK

The NBG has agreed to collaborate with the Department of Chemistry, Muslim University, Aligarh, for providing assistance for the project on "Search for useful vegetable oils from the seeds of native Indian herbaceous plants." The NBG would particularly help in the collection and identification of seeds. The seeds thus collected would be lodged in the NBG's Seed Herbarium to be used for seed morphological studies.

2. TRAINING

2.1 TRAINING IMPARTED

2.1.1 Dr. S. D. Dubey, Scientist, Vivekananda Parvatiya Krishi Anusandhanshala, Almora, was imparted training in Methods of Plant Tissue Culture, from January 19 to 29, 1976.

2.1.2 Mr. Dipendra Bhandari, Mr. P. C. Kakkar, DIG (Int.) and Mrs. A. Tayal of Lucknow were imparted training in cultivation of the White Mushroom.

3. LECTURES, SYMPOSIA, SEMINARS, CONFERENCES AND WORKSHOPS

3.1 LECTURES AT NBG

3.1.1 "Visit to U.K." — Dr. Khwaja J. Ahmad, Scientist, NBG ... ... March 3, 1976

3.1.2 "Some aspects of New Zealand vegetation" — Dr. J. E. Braggins, Lecturer, Department of Botany, University of Auckland, New Zealand March 11, 1976

3.2 EXTENSION LECTURES DELIVERED BY DR. T. N. KHOSHOO AT UNIVERSITIES

3.2.1 "Patterns and pathways of evolution in ornamentals" — Department of Botany, Marathwada University, Aurangabad ... ... Feb. 3, 1976

3.2.2 "Ornamental horticulture — A Field of Applied Botany" — Department of Botany, Marathwada University, Aurangabad ... Feb. 2, 1976

3.2.3 "Prospects of Floriculture Industry in India" — Chandra Shekhar Azad University of Agriculture and Technology, Kanpur ... ... Feb. 11, 1976

3.3 DEPARTMENTAL SEMINARS

3.3.1 "Discriminant function and heterosis in tomato" — Dr. K. R. Khanna ... ... Jan. 14, 1976

3.3.2 "Sub-specific reproductive barriers in Amaranthus tricolor" — Dr. M. Pal ... Jan. 31, 1976

3.3.3 "Mode of action of chemical mutagens" — Mr. Anil Misra ... ... Feb. 9, 1976

3.3.4 "Heterosis in tomato" — Dr. C.H. Misra March 25, 1976

3.4 SYMPOSIUM ORGANISED

The NBG, in collaboration with the Ramganga Command Development Authority, Govt. of U.P., Kanpur and Essential Oils Association of India, Kanpur, organised a Symposium on the "Development of Essential Oils in Uttar Pradesh", at Kanpur, on January 17 and 18, 1976. Dr. T. N. Khoshoo, Director and Mr. B. R. Juneja, Scientist, NBG were members and Dr. L. D. Kapoor, Scientist, NBG, the Convenor of the Organizing Committee. Dr. L. D. Kapoor and Mr. B. R. Juneja were also the convenor and

member, respectively, of the Publication and Programme Sub-Committee.

3.5 CONFERENCE, SYMPOSIA & WORKSHOP ATTENDED

3.5.1 Drs. L. D. Kapoor, M. I. H. Farooqui and P. N. Saxena, Scientists and Dr. C. R. Mitra, Scientist Emeritus, attended the 63rd Session of the Indian Science Congress, held at Waltair, Andhra Pradesh, from January 3-7, 1976 and presented the following special invited papers under the focal theme "Science and Integrated Rural Development":

3.5.1.1 Economic utilization of saline-sodic soils for the cultivation of medicinal and aromatic plants, by Dr. L. D. Kapoor and Shri P. N. Misra.

3.5.1.2 Role of plant and seed gum industry in the development of rural economy, by Dr. M. I. H. Farooqui.

3.5.1.3 Utilization of sewage for production of algae as animal feed, by Dr. P. N. Saxena.

3.5.1.4 Role of tree-born seeds in rural economy, by Dr. C. R. Mitra.

3.5.2 Messrs. B. R. Juneja and S. M. Lal, Scientists attended the R & D Project Management Workshop-cum-Training Programme, organised by Planning Division, CSIR, at the National Institute of Oceanography, Panaji, Goa ... ... Jan. 19-30, 1976

3.5.3 Dr. H. C. Chaturvedi, Scientist, participated in the 'Plant Tissue Culture Conference', held at the National Chemical Laboratory, Poona ... March 19-21, 1976

4. PUBLICATIONS

4.1 RESEARCH PAPERS PUBLISHED

4.1.1 Chaturvedi, H. C. — Propagation of *Dioscorea floribunda* from *in vitro* culture of single-node segments. *Curr. Sci.*, 1975, 44: 839-41.

4.1.2 Dogra, P. D., Pal, A. and Tandon, S. — Studies on breeding systems in *Moringa*: 3. Fruit-, Seed-set and seed germination in two flowering periods of one year of the 'Baramassi' *Moringa oleifera* and chromosomal pairing in the F_1 hybrid from *M. oleifera* X *M. concanensis*. *Incompatibility Newsletter*, 1975, 6: 46-51.

4.1.3 Dogra, P. D. and Srivastava, B. L. — Crossability of some intra- and inter-specific crosses of *Morus* on the basis of embryology and seed-set. *Incompatibility Newsletter*, 1975, 6: 52-55.

4.1.4 Gupta, M. N. — Mutation breeding of vegetatively propagated ornamentals. *Delhi Garden Magazine*, 1976: 3-4.

4.1.5 Ohri, D. and Zadoo, S. N. — Cross compatibility studies in some *Bougainvillea*. *Incompatibility Newsletter*, 1975, 6: 35-39.

4.1.6 Paul, S. R. — *Smilax siamensis* T. Koyama, new to Indian flora. *Acta Botanica Indica*, 1975, 3: 167-68.

4.1.7 Singh, S. P. — Note on propagation of *Hibiscus rosa-sinensis* L. cv. 'Alipore Beauty' under intermittent mist. *Pantnagar J. Res.*, 1976, 1(i): 73-74.

4.2 POPULAR ARTICLES PUBLISHED

4.2.1 Balasubrahmanyam, Y. R. and Khanduja, S. D. — Harvest grapes early. *Intensive Agri.*, 1976, 13 (11): 16.

4.2.2 Juneja, B. R. -- National Botanic Gardens, Lucknow. Proc. Symposium on Development of Essential Oils in Uttar Pradesh, Kanpur, Jan. 17 and 18, 1976: 1-8, Plates-5.

4.3 PAPERS PRESENTED AT A SYMPOSIUM

The following papers were presented at the Symposium on Development of Essential Oils in Uttar Pradesh, held at Kanpur, on January 17 and 18, 1976 and abstracts published:

4.3.1 Kapoor, L. D. — Introduction of Mentha species — A great break-through in the essential oil and perfumery industries. pp. 27-28.

4.3.2 Pandey, M. B. — Spacing effect on the herbage and oil yield in Camphor Tulsi (Ocimum kilimandscharicum). p.38.

4.3.3 Pandey, M. B. and Asthana, J. R. — Effect of N.P.K. on herbage yield of Camphor Tulsi (Ocimum kilimandschari...) in saline-alkali soils. p. 38.

4.3.4 Sharma, M. L. — Development of peppermint industry in U.P., p. 28.

5. PH.D. DEGREE AWARDED

5.1 "Physiology of Citrus-Virus Complex", Kanpur University, Kanpur — Mr. A. K. Verma.

The investigation entitled "Physiology of Citrus-Virus Complex" comprises the survey and indexing programme conducted for the occurrence of tristeza, greening and their complex in the citrus growing belt of Uttar Pradesh. Physiological changes in the host brought about by the above pathogens alone as well as in complex form were studied and the suppression of symptoms through growth regulators, RNA based analogues and gamma irradiation was attempted.

The experiment on the standardization of inoculation technique revealed that tissue and side grafting (5-8 cm cambial contact) produced the maximum infection with tristeza and greening disease, respectively.

Fluctuations in the contents of RNA, acid soluble nucleotides, nitrogen, various amino-acids, phosphorus, potassium and calcium, corresponding to different modes and stages of infection with these pathogens acting singly or in complex form, were studied. The oxygen uptake was found to be greater during the early stages of all types of infections than in control, but, during later stages, it started declining and was lower than that of the non-infected tissues after 60 days.

Growth regulators, used in this investigation, did not suppress the symptoms produced by any of the infections. However, exposure of plants, grafted with infected buds, to 6.0, 8.0, 10.0 and 12.0 Krad of gamma irradiation, did reduce the severity of tristeza symptoms; lower doses were ineffective. In complex infection also, only tristeza and not the greening, symptoms were reduced.

6. FLOWER SHOW

6.1 THE ANNUAL ROSE AND GLADIOLUS SHOW

The Annual Rose and Gladiolus Show of NBG (NBG Newsletter, 1976, 3:14) was held on January 17 and 18, 1976. It fetched 1000 entries from 168 exhibitors and 259 prizes, including nine running challenge cups and shields, were given away to the prize-winners by His Excellency Rabindrah Ghurburrun, High Commissioner for Mauritius in India, who presided over the Prize Distribution Function on January 18, 1976.

Besides a large number of excellent entries, the mushroom cultivation technique and new F_1 hybrid marigolds were exhibited. A large number of plants and gladiolus spikes were put on sale.

7. PERSONALIA

7.1 RESEARCH FELLOWS

7.1.1 Appointments

(a) Post Doctoral Research Fellow

(i) Dr. J. P. Singh	w.e.f.	Jan. 27, 1976

(b) Senior Research Fellows

(i) Mr. K. N. Chaturvedi	w.e.f.	Jan. 21, 1976
(ii) Mrs. S. Kochhar	w.e.f.	Feb. 4, 1976
(iii) Mr. Deepak Ohri	w.e.f.	Feb. 10, 1976

(c) Junior Research Fellows

(i) Mr. G. V. Subrahmanyam	w.e.f.	Jan. 15, 1976
(ii) Mr. R. B. Srivastava	w.e.f.	Jan. 19, 1976

7.2 DISTINGUISHED VISITORS

7.2.1	Dr. R. K. Bammi, CIPLA, Bangalore ...	Jan. 2-4, 1976
7.2.2	Prof. H. C. Kroneberg, Professor of Pharmacology, Frankfurt University, Germany ...	Feb. 10, 1976
7.2.3	Dr. Peter Goodford, The Welcome Foundation, Kent, England	Feb. 10, 1976
7.2.4	Miss Rosa Schwyzer, Switzerland ...	Feb. 10, 1976

7.2.5 Shri M. K. Venkataraman, Deputy Financial Advisor, Ministry of Finance (Department of Expenditure), Government of India. New Delhi... Feb. 17-18, 1976

7.2.6 Shri P. N. Haksar, Deputy Chairman, Planning Commission, Government of India and Vice President, CSIR, New Delhi ... ... Feb. 18, 1976

7.2.7 Prof. A. K. Sharma, Ghosh Professor and Head, Department of Botany, University College of Science, University of Calcutta, Calcutta. Feb. 26, 1976

7.2.8 Dr. A. B. Joshi, Director, Indian Agricultural Research Institute, New Delhi ... Feb. 26-28, 1976

7.2.9 Dr. J. E. Braggins, Lecturer, Department of Botany, Auckland University, New Zealand. March 12, 1976

7.2.10 Prof. T. K. Bose, Professor and Head, Department of Horticulture, Faculty of Agriculture, Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani, District Nadia, West Bengal ... March 24, 1976

8. FORTHCOMING EVENTS

8.1 BOUGAINVILLEA FESTIVAL ... April 10-11, 1976

8.2 ANNUAL DAY LECTURE by Prof. B. M. Johri, Emeritus Professor of Botany, University of Delhi, Delhi on "Some Applications of Experimental Embryology" ... ... April 12, 1976

8.3 ANNUAL DAY ... ... April 13, 1976

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1. RESEARCH ROUND-UP

1.1 PALYNOLOGICAL RESEARCH

Being a partner in the biology of reproduction leading to seed production, the pollen grains assume great significance in plant research. The palynological studies being carried on at the National Botanic Gardens and reviewed below broadly fall in three groups - (i) Morphographic Palynology, (ii) Agricultural Palynology, including bee botany and (iii) Medical Palynology.

1.1.1 Morphographic Palynology

The morphostructure, typified by exine of pollen grains, is of fundamental importance in plant taxonomy, phylogeny and evolution and is a major factor in the recognition and identification of the pollen grains occurring in a variety of media, such as, the air, water, honeys, sedimentary deposits, animal faeces, etc. It is in this context that the pollen morphology has been studied at the NBG.

1.1.1.1 Pollen Herbarium : During the course of the studies, a pollen herbarium has been set up which contains over 6000 pollen slides, with corresponding pollen description cards and an index to the pollen slides collection.

1.1.1.2 Pollen Morphology and Plant Taxonomy: The pollen grains of a large number of Indian plants have been described and illustrated. Particular mention may be made of a monographic work on the pollen morphology of Indian Monocotyledones, and of the pollen flora of the Western Himalayas.

Pollen morphology is resolved into 5 groups of characters, namely, aperture, exine ornamentation, size, shape and exine strata, in the order of their importance. These characters, singly or in combination, provide a working basis for the differentiation of taxa, as described below:

(a) Aperture:- In the family Butomaceae, Butomus umbellatus is monocolpate, while Butomopsis lanceolata is pantoporate, suggesting the separation of Butomopsidaceae from Butomaceae. Among the varieties of Caltha palustris, the grains are 3-colpate in the variety normalis and pantoporate in the variety alba, indicating the need for the elevation of the variety alba to a species.

(b) Exine ornamentation:- The exine ornamentation differs markedly in species of Bauhinia, being pilate in B. acuminata, striate in B. krugii, verrucate in B. retusa, reticulate in B. racemosa, reticulate-tuberculate in B. purpurea and spinulate in B. malabarica.

(c) Exine strata:- The exine strata is a decisive character in the delineation of species of Argyreia and Ipomoea of Convolvulaceae, and of Hibiscus and other genera of Malvaceae.

(d) Shape:- The pollen shape is not a sound basis for taxa differentiation; however, it is an important subsidiary character and was found useful in differentiating species of unipalnous taxa.

(e) Size:- Grains are smaller (av.142/μ) in Stachytarpheta indica and larger (av. 196/μ) in S. mutabilis. Similarly, among the 3 species of Malva, the size varies from 74-78/μ in M. rotundifolia, 90-98/μ in M. parviflora and 105-126/μ in M. sylvestris.

(f) Special types:- Pollen grains remain united as tetrads or polyads in the plants belonging to a few families, like Orchidaceae, Asclepiadaceae and Mimosaceae. The number of cells in the polyad is sometimes a useful character in the differentiation of species, e.g. the polyad is 12-celled in Albizzia amara and 16-celled in A. lebbek.

(g) General remarks:- The separation of Paeoniaceae from Ranunculaceae, Nelumbonaceae from Nymphaeaceae, Fumariaceae from Papaveraceae, Bombacaceae from Malvaceae and Cuscutaceae from Convolvulaceae finds support from pollen morphology which, however, does not favour the breaking up of the Liliaceae into several families, as suggested by Hutchinson, and other taxonomists. On the other hand, the taxo-

nomic circumscription, as defined by Bessey, Hallier and Engler, may be considered natural because of the fact that mulapalyny, as observed in the family, represented an early stage in the evolution of the monocotyledons. Similarly, the splitting of the Scitamineae with inaperturate pollen is hardly justified as the family is unipalynous. So is the case with the splitting up of Urticaceae into Moraceae, Cannabinaceae and Ulmaceae, although Cannabinaceae shows some differences in its pollen to merit a separate taxonomic status. A study of the Indian species of Daphne leads to the conclusion that the species D. bholua and D. papyracea should be united under a single species, D. cannabina, as originally stated by Hooker.

Caltha palustris, consisting of the varieties alba and normalis, offers an interesting instance of the influence of ecology on pollen morphology. The species grows along the Northern temperate belt of the world and its pollen grains are characteristically 3-colpate but for the variety alba, occurring in Kashmir valley alone, in which the grains are pantoporate. The Kashmir flora constitutes a synthesis of plants that migrated to the valley during early Pleistocene times, consequent to the exposure of land covered previously by the 'Karewa' lake. In the wake of these migrations, new mutations and breeding might have produced new bioforms, one of which is represented by the variety alba with pantoporate pollen grains.

Pollen morphology is also a reflection of the cytology of plants. For example, a study of the Sisymbrium irio complex has shown that the pollen grains are 3-zonocolpate in the diploid. In all other cytological forms, the fundamental 3-zonocolpate form, as in diploid, occurs alongwith the new forms, namely, 3-syncolpate in the triploid-caulis (grown in moist sun), 4-zonocolpate and 4-parasyncolpate in tetraploid-caulis (grown in dry shade) and spiraperturate in tetraploid-subcaulis. The hexaploid stands apart with 2-"aperturate-operculate" pollen type, alongwith a few

4-zonocolpate and abnormally spiraperturate types. Polyploidy has been suggested as the possible reason for the changes in pollen morphology. Similar investigations have been made with regard to Amaranthus spp., Cajanus cajan and Corchorus spp.

1.1.1.3 Pollen Morphology and Plant Phylogeny:- Pollen and spore morphology also reflects plant evolution and is an index of phylogenetic taxonomy. In a morphological analysis of many spore-pollen morphoforms in the plant kingdom, it has been observed that the germinal apertures in the spores of Thallophyta are not well-marked; Archegoniatae composed of bryophytes, pteridophytes and gymnosperms, are characterised by three well-marked morphotypes, namely, trilete, monolete and alete; the angiosperms contain an arrary of apertural morphotypes. This observation has led to the suggestion that the plant kingdom could be classified palyno-phylogenetically into three divisions - namely, Amorphosporophyta (syn. Thallophyta), Trimorphosporophyta (syn. Archegoniatae) and Polymorphosporophyta (syn. Anthophyta or Angiospermae).

Regarding the phylogeny and evolution of the primitive angiosperms, it has been argued that those taxa, which reflect the trimorphous trend of morphological evolution as that in the Trimorphosporophyta (Archegoniatae), should be considered primitive and should form the base for gaining an understanding of the phylogeny and evolution of the angiosperms. Among the various systems of plan classification, the Magnoliidae of Cronquist (1968) appears in line with the facts of pollen phylogeny, and two evolutionary stocks of dicotyledons, one represented by the fundamental monocolpate pollen, and the other by tricolpate pollen, designated as the "Magnolian stock" (Magnoliaceae and its allies), and the "Ranalian stock", respectively, have been noticed. Further, the Ranalian stock represents new evolution, being completely devoid of the ancient monocolpate form. The monocots, being dominantly monocolpate, might

have evolved parallely with the Magnolian dicots. The above data forms tha basis for proposing the theory of the "triphyletic" origin of angiosperms.

1.1.2 Agricultural Palynology

The study of the pollen biology of the cultivated plants falls within the scope of agricultural palynology. Since the crop plants are mainly insect-pollinated, the science of insect botany (bee botany, to be precise) forms an allied subject.

1.1.2.1 Pollen Morphology of Cultivated Plants:- For the first time, pollen morphology has been used for establishing cultivar taxonomy, and several crop and ornamental plants have been covered in the study. For example, in Canna, pollen variations could conveniently be used to differentiate cultivars. The pollen in the species are fundamentally inaperturate and spinate, and have indistinct stratification. An evolutionary reduction series, starting from the spinate to the psilate and pilate (showing clear stratification) pollen, could be observed in the cultivars, and further a few porate grains were observed in just two cultivars (Flamingo & M.S. Thacker) which indicated the taxonomic uniqueness of those two cultivars. The pollen of cereals fundamentally have monoporate pollen, and a graphical presentation of size range provides a clue to the separation of varieties of Zea mays. The finding, that the effect of acetolysis - the grains enlarging along specific directions when acetolysed, itself is an index of varietal taxonomy, is of special importance.

The study of the cultivated Brassica and Linum spp. has indicated the potential use of electron replicas of pollen in differentiating the varieties. The pollen grains of Linum has been found to be made up of islands in various sizes and shapes, each with a central spine, and with or without lateral spines at the corners forming the circumference of the island. The islands are

broadly divisible into megaislands and micro-islands. In L. usitat ssimum alone, the various varieties could be differentiated from th electron replica patterns.

In Rauwolfia serpentina, an odd gigantic plant has been observed to contain a certain percentage of large grains, suggestin that the particular individual is a 'pollen mutant'. Since pollen morphology is an index for checking the adulteration of floral drug pollen morphology of Indian medicinal plants was studied and a poll key was provided.

The cultivated plants do represent an advanced level of plant evolution, and this fact is more or less confirmed by the presence of advanced pollen morphoforms, namely, tricolporate and pantoporate, in a majority of the families of the dicotyledonous crops and monoporate in monocotyledonous ones. The Gramineae (cereals) among the monocots, and the legumes (pulses) among the dicots together constitute a majority of the crop plants, and both possess highly evolved pollen forms, namely, the monoporate and the tri-colporate, respectively. The crops, being the result of breedi are "a significant link in evolution controlled by man", and this fact is amply reflected in pollen morphology.

1.1.2.2 Pollen Germination and Storage:- A knowledge of the germi nation potential of pollen grains is very useful in plant breeding. It has been contended that the selection of pollen with the desired potential, from desired individuals of varieties or species, should necessarily precede breeding, and the use of this knowledge in bree ing would certainly change the technological pattern of present day plant breeding. This is the basic principle on which pollen germi-nation studies have been made.

Presuming that the preservation or storage of pollen for longer periods would be effective at the stage of flower bud itself

experiments were made to determine the germination potential of pollen at various stages of maturation of the flower bud, and it was found that the mature flower buds with undehisced anthers in Citrus medica and Impatiens spp. and with dehisced anthers in legumes, would be the most suitable for storage for retaining the maximum pollen viability.

The selection of any particular pollen strain (with a certain germination potential) can possibly be made only if the physiological strain can be recognised from its surface morphology. In other words, it is important to establish the morpho-physiological interlink, in the pollen strains, which together constitute the pollen mass in any one plant. Indications of the morphophysiological interlink could be noticed in Vitis vinifera in which large grains showed incipient or no germination at all, while the small grains showed profuse germination.

1.1.2.3 Pollen Production:- The number of grains produced per anther, per flower and per plant is of importance in gaining a full knowledge of the pollen biology of agricultural crops. In cultivars of Psidium guajava, the number of grains per anther ranged from 139-660, and four production groups, namely, A (200-300), B (301-400), C (401-500), and D (601-700) could be demarcated. The number of pollen per anther among the varieties of Luffa cylindrica is 1055 in var. 5617, 7286 in var. 5610, 7683 in var. 5122, 12063 in var. 5127, and 26100 in var. Gwalior.

1.1.2.4 Fungal Relations of Pollen:- Whether pollen and fungi have a symbiotic relationship, or whether pollen are infected by fungi and whether such an association benefits pollen grains, has been engaging the attention of workers all over the world. In this connection, the finding of fungal infection on the pollen of Schizanthus pinnatus is a pioneering one. An experimental study of pollen-fungal culture has shown that the pollen grains of Citrus medica form a good substrate for the fungal growth.

1.1.2.5 Bee Botany:- The pollen grains contained in honeys, or those consi ting of honey-bee l ads, provide a picture of the bee-pasturage, and such a knowledge would in turn lead to the establishment of apiary gardens. A pollen analysis of 76 samples of Indian honeys has served to recognise Eugenia, Nephelium, Sapindus, Putranjiva, Citrus, Pletranthus and Brassica among the nectar yielding plants, and Holoptelea, Alnus, Borassus and other palms among the pollen yielding plants.

The pollen analysis of honey bee pollen-loads from Kangra and Lucknow has indicated that the honey bees have single plant preferences provided the single source provides the requisite amount of pollen food they require.

The study of bee botany covers all aspects of flower biology including pollen biology, and the areas of botanical studies covered include the flowering process, honey bee visits and behaviour, microscopic investigation of the floral elements, particularly, the nectariferous structures, pollen production, physical and chemical properties and morphology of pollen grains. The data on the above aspects have been presented with regard to Datura stramonium, Moringa pterigosperma and Antigonon leptopus. A study of the flower of Cajanus cajan has indicated the presence of bands of nectariferou tissues on the wings.

1.1.3 Medical Palynology

1.1.3.1 Atmospheric Pollen Surveys:- A knowledge of the airborne pollen-spore allergens is of fundamental importance in the diagnosis and treatment of allergy patients. Atmospheric pollen surveys have been carried out at Vellore, Tamilnadu, in continuation of the work done at Lucknow and Almora. It has been observed that the fungal spores abound in the air at Vellore, while the pollen grains of Holoptelea and grasses are dominant in the atmosphere of Lucknow.

Apparatuses have been designed for the collection of atmospheric pollen and for the mass collection of pollen from plants, for use in the allergy clinics. Investigations on the relevant aspects of floral biology, such as, anther morphology, floresis and anthesis, pollen production and dispersion are also being carried out.

2. LECTURE, SEMINAR AND WORKSHOP

2.1 LECTURE

2.1.1 "Some applications of experimental embryology" - Prof. B.M. Johri, Department of Botany, University of Delhi, Delhi .... April 12, 1976

2.2 DEPARTMENTAL SEMINAR

2.2.1 "Cytological behaviour of a desynaptic Verbena" - Dr. O.P. Arora .... May 27, 1976

2.3. WORKSHOP ATTENDED

2.3.1 Drs. S.D. Khanduja and V.R. Balasubrahmanyam, Scientists, attended the Fruit Research Workshop, held at Hyderabad, during May 24-28, 1976.

3. PUBLICATIONS

3.1 RESEARCH PAPERS PUBLISHED

3.1.1 Awasthi, Y.C., Bhatnagar, S.C. and Mitra, C.R. - Chemurgy of Sapotaceous plants: Madhuca species of India. Economic Botany, 1975, 29: 380.

3.1.2 Bhatnagar, S.C., Misra, G., Nigam, S.K., Mitra, C.R. and Kapoor, L.D. -- Diosgenin from Balanites roxburghii and Trigonella foenum-graecum. Quart. J. Crude Drug Res., 1975, 13: 122.

3.1.3 Misra, G., Huneck, S. and Hale, Mason, E. -- Mitteilungen uber Flechteninhaltstoffe: Die Flechtenstoffe einiger Indischer Parmeliaceen. Philippia, 1976, 3: 20.

3.1.4 Nigam, S.K., Chaturvedi, A.K., Parmar, S.S., Bhatnagar, S.C., Misra, G. and Sastry, B.V.R. -- Anti-inflammatory and anti-convulsant properties of some natural plant Triterpenoids Pharmacol. Res. Comm., 1976, 8: 199.

3.1.5 Nigam, S.K., Misra, G. and Yadav, N. -- Triterpenoids of Adenanthera pavonina bark. Planta Medica, 1976, 29: 176.

3.1.6 Nigam, S.K.and Yadav, N. -- Chemical examination of Bridelia montana. Quart. J. Crude Drug Res., 1975, 13: 127.

3.1.7 Sharga, A.N. -- Horticultural description and performance studies of some Dahlia cultivars. Prog. Hort., 1975, 7(3):29-3

3.2 POPULAR ARTICLES PUBLISHED

3.2.1 Bhutani, J.C. -- Golden Shower - A climbing beauty. Indian Farmer's Digest, 1976, 12.

3.2.2 Juneja, B.R. and Sharma, S.C. -- Why Bougainvillea Festival ? The National Herald, April 9, 1976.

3.2.3 Rao, D.N. Krishna -- A highly nutritive green plant for common man's use in India. Lal-Baugh Journal of Mysore Horticultural Society, 1975, 20(1 and 2).

3.2.4 Sharma, S.C. and Tandon, R.K. -- 'Bougainvillea -- ghar/aur bagh ki shobha'. The Swatantra Bharat, April 10, 1976.

4. PH.D. THESIS SUBMITTED

4.1 "Ecological Studies of Moringa oleifera Lamk and M. concanensis Nimmo., with special emphasis on organic production and mineral status" -- Mr. S.C. Verma, Gorakhpur University, Gorakhpur.

5. TECHNICAL ASSISTANCE/CONSULTANCY

5.1 Advice on Garden Layout and Improvement was provided to seven parties from Lucknow, Kanpur, Faizabad and Hyderabad.

5.2 Gamma irradiation facility was provided to four institutes from Lucknow, Pratapgarh and Azamgarh.

5.3 Advice on the commercial cultivation of grapes in Hardoi was provided to the Zila Parishad, Hardoi, U.P.

6. FLOWER SHOW

6.1 THE FIRST BOUGAINVILLEA FESTIVAL

In order to give fillip to Bougainvillea cultivation all over the country, the Bougainvillea Society of India desires to set up regional branches in different parts of India and has requested the National Botanic Gardens to take steps to set up a Regional Branch for Uttar Pradesh with its Headquarters at Lucknow. As a first step in that direction, therefore, the NBG organised a first ever Bougainvillea Festival on April 10 and 11, 1976, to provide an opportunity to the Bougainvillea enthusiasts to expose their Bougainvillea collections to the public eye and to come together and exchange their views regarding setting up a U.P. Branch of the Bougainvillea Society of India.

As a first venture it exceeded the expectations of the organisers who had, on account of increasing heat and dusty winds, not expected as many entries as actually turned up at the Festival. As many as 50-exhibitors submitted 215 entries in all.

It was surprising indeed that about 200 Potted Bougainvilleas of a large array of colours and shades and in excellent health were displayed at the Festival.

Mr. Mehmood Butt, Chief Secretary, Govt. of U.P., and a great Bougainvillea enthusiast himself, presided over the Prize Distribution Function, held in the evening of April 10, 1976, and gave away 48 prizes to the prise-winners. He alsc offered an ad hoc grant of Rs.1000/- to the organisers of the Festival to encourage their efforts to popularize Bougainvillea.

6.1.1 New Cultivars by NBG:- The NBG, which has over 120 cultivars in its Bougainvillea collection, exhibited, besides about 100 of these, seven new cultivars developed by them, viz., 'Begum Sikander' (bicoloured), 'Shubhra' (white), 'Parthasarathy' (orgnge/red and variegated), Dr. B.P. Pal (white), 'Archana' (variegated), Mary Palmer Special (two flowered type - magenta and white) and Tetra Mrs. McClean (burnt orange).

The NBG also displayed some seeded types developed by it from such universally known sterile cultivars as Mary Palmer, as their development has given a new dimension to Bougainvillea breeding which had almost reached a plateau because of the sterility of the present-day cultivars. The fertile types are being used for producing new hybrids, the most attractive of which is a cultivar with bracts having a white centre and delicate pink margins. This cultivar has been named 'Begum Sikander', after the name of Sikander Mahal Begum, a favourite queen of Nawab Wajid Ali Shah and after whom the Nawab named the garden as Sikander Bagh. There are many blotched varieties in the pipeline.

The NBG has also perfected a method for mass-propagation o a new type from a single seedling, by means of tissue culture technique. This innovation, coupled with mist-propagation, will greatl help spread Bougainvillea culture. This technique was also displayed at the Festival.

7. ANNUAL DAY

The Annual Day of the National Botanic Gardens was celebrated, as usual, on April 13, 1976, with great enthusiasm. Sports and atheletics were organised and a report of the R & D activities of the institute for the preceding year was presented by Dr. T.N. Khoshoo at the Prize Distribution Function which was presided over by Prof. B.M. Johri, Emeritus Professor of Botany, Delhi University, Delhi. A very important addition to the celebrations this year, however, was the organisation of the "Annual Day Lecture", which was delivered by Prof. Johri, on the subject of "Some Applications of Experimental Embryology". Another addition of much social value was the first ever Community Dinner of the members of the staff and their families, arranged the same night on the lawns of the garden.

Given below is a summary of the First Annual Day Lecture, delivered by Prof. B.M. Johri, on April 12, 1976, on

7.1 SOME APPLICATIONS OF EXPERIMENTAL EMBRYOLOGY

7.1.1 Historical

When Schleiden and Schwann (about 1838) put forward the concept of 'cell theory', they pointed out that each cell functions independently as well as in association with other cells. Later, it was thought that the function of a cell is determined by its position.

When the cells divide methodically, they differ in shape, size, volume, vacuolation, size of nucleus, and in many other ways. This is the primary process of 'differentiation' in cells. If the division continues without any further differentiation, the cell mass will continue to grow and various organs of a plant would not be produced, i.e., there would be no 'organogenesis'. Different organs of a plant have characteristic types of cells which is also a process of differentiation, commonly referred to as 'histogenesis'. Unless histogenesis and organogenesis followed an orderly sequence.

a normal plant would not be produced. Thus, the 'form, structure, and function' in plants is determined by well-regulated morphogeneti differentiation.

It is not at all easy to study all the processes involved in growth, development, and differentiation in intact plants. Therefore, a German botanist, Gottlieb Haberlandt (1902) designed a technique by which isolated organs, tissues, and cells could be grown under completely controlled conditions. His objective was to develop a tool to explore morphogenesis, and to demonstrate totipotency of cells. He could never suspect that the in vitro culture technique would become a valuable aid in the study of morphogenetic processes. While he was not very successful in his attempts, the credit for establishing and refining the techniques (during 1930s) goes to an American Philip R. White, and two Frenchmen P. Nobe'court and R.J. Gautheret.

To emphasize the importance of tissue culture research, let us examine some of the applications which are profoundly associated in economically-oriented activities.

7.1.2 Genetic Improvement of Crops

The technique of embryo culture has served plant hybridizers for many years. Test-tube pollination and fertilization followed by normal development of endosperm, embryo and seed with ovary and ovule cultures will surely find utilization in plant breeding. The attainment of haploid plants through anther and microspore cultures has stirred considerable excitement. Haploid plants will minimize hybridization steps considerably, and help markedly in the recovery of mutants. Another even more exciting development is the culture, regeneration, and development of plants from isolated protoplasts. The fusion of protoplasts of genetically distinct species and the achievement of somatic hybrids -- howsoever difficult -- is a distinct possibility. We may even expect genetic transformation of

higher plants. It is conceivable that an alternate and a much abbreviated procedure for developing a new crop variety would be worked out in the near/distant future.

7.1.3 Endosperm

Let us now examine some other areas in which tissue cultures have yielded spectacular results. One such area is that of endosperm culture. In vivo the endosperm is an undifferentiated mass of cells in seeds. It was thought that this tissue is completely incapable of successful growth in cultures. Since earlier attempts to culture endosperm tissue did not prove encouraging, not much attention was paid to this study. Subsequently, several investigators did succeed in obtaining callus which remained undifferentiated. During the last decade it has indeed been possible to obtain callus, roots, shoots, and plantlets from the mature endosperm tissue of several taxa of Euphorbiaceae, Santalaceae, and Loranthaceae. The differentiated organs are invariably triploid.

7.1.4 Polyembryony

Tissue culture is a very useful technique for the induction of polyembryony. Such embryos, usually referred to as embryoids, can be obtained from all vegetative and reproductive organs/tissues. While younger stages are quite frequent, not in many taxa is the mature stage attained. In fact, on semi-solid media, the younger undifferentiated embryos germinate directly.

7.1.5 Plantlets

Mere demonstration of the development of a plantlet in cultures is not enough. It has to be transferred to soil where the growth and development should be normal. In some cases the test-tube plants can no doubt be transferred directly to soil (after a careful washing of roots to free from agar), in others the plants must be gradually adapted by transferring them to vermiculite with nutrient solution, a mixture of virmiculite and sterile sand, sterile sand, a mixture of garden soil and sand, and, finally, garden soil. Even then some of the in-vitro - grown seedlings may

fail to establish. This is essentially due to the fact that the roots are rather poorly developed, especially the vascular tissue. An alternative method has been suggested. The hypocotyl with the shoot may be excised and the roots may be induced on this explant. How far this would be successful remains to be tested.

7.1.6 Clones

Rapid clonal multiplication of selected varieties. The propagation can be achieved through cultures of young inflorescence inflorescence node, shoot tip, young leaf tip, lateral bud, embryo, cotyledon, hypocotyl, bulb scale, stem, rhizome tip, root, seedling, flower bud, ovary, ovule, necellus, and other organs and tissues.

There are a few other applications of tissue culture, not within the realms of experimental embryology, which are also worthy of mention.

7.1.7 Disease-free Clones

Recovery of disease-free clones, and preservation of valuable germ-plasm. The use of organ and cell culture methods in the re-establishment of pathogen-free clones has attracted world-wi attention. These methods result in the restoration of vigour and yield due to infection. Also, they provide a means to expedite the movement of plants from one country or region to another. If combined with freeze preservation methods, cell and organ cultures would also provide a method for the conservation of valuable patho free germ-plasm.

7.1.8 Production of Pharmaceuticals and Other Natural Products

There has been substantial research in this area, but a successful commercial application remains unrealized.

7.1.9 Concluding Remarks

There is hardly a discipline of plant science where cell, tissue, and organ culture sfudies have not proved useful. Plants can be raised from isolated single protoplasts, fused protoplasts

(inter-specific and intergeneric), single cells, clumps of cells, and almost all tissues and organs. Whenever success is not achieved, it may be due to several causes, e.g., (a) unsuitable stage of explant, (b) inadequate nutritional conditions, (c) leaching of inhibitors in the nutrient medium, and such other related physical and chemical conditions.

While our knowledge of cell, tissue and organ cultures has advanced very rapidly during the last 15 years, numerous problems still remain to be solved. There is no doubt that the progress of our knowledge of physiology, biochemisty and allied areas would be very useful in meeting these challenges.

8. PERSONALIA

8.1 APPOINTMENT

8.1.1 Dr. T.N. Khoshoo, Deputy Director-in-Charge, appointed on promotion as the Director, National Botanic Gardens, Lucknow w.e.f. May 14, 1976.

8.2 TRANSFERS

8.2.1 Mr. Vidya Sarup, Section Officer, transferred to the CSIR Headquarters, New Delhi w.e.f. April 30, 1976.

8.2.2 Mr. P.N. Malhotra, Accounts Officer, transferred on promotion to the CSIR Headquarters, New Delhi, as Senior Accounts Officer (Internal Audit), w.e.f. May 7, 1976.

8.3 RESEARCH FELLOW

8.3.1 Junior Research Fellow Appointed on Transfer

8.3.1.1 Mr. C. Ravi Kumar, on transfer from CIMAP, Bangalore ... ... w.e.f. 23.6.1976

8.4 DISTINGUISHED VISITORS

8.4.1 Dr. Astadjov Nikola, Institute for Rose, Kazanlik, Bulgaria ... ... March 27 - April 3, 1976.

8.4.2	Dr. P.R. Mahadevan, Chief R & D, Antibiotics Plant, Virbhadra (Risikesh), U.P.	April 6, 1976
8.4.3	Dr. K.S. Gopal Krishnan, Chief Mycologist, Hindustan Antibiotics Ltd., Pimpri, Poona	April 6, 1976
8.4.4	Prof. B.M. Johri, Emeritus Professor of Botany, University of Delhi, Delhi	April 12-13,1976
8.4.5	Dr. Luis R. Capo', Director, Desarrollo Tecnico Vice ministerio Industria Farmaceutica Calle 23 YN, Vedado La Habana, Cuba	April 24,1976
8.4.6	Dr. P.C. Jain, Messrs Hindustan Lever Ltd., Hindustan Lever House, Backbay Reclamation, Bombay	May 10, 1976
8.4.7	Shri O.V. Kuruvilla, Member, Central Board of Direct Taxes and Ex-Officio Joint Secretary to the Govt. of India, New Delhi	June 11, 1976

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1. RESEARCH ROUND-UP

1.1 PTERIDOLOGICAL RESEARCH

Ferns, about 90% of which are confined to the tropical forests, are highly prized as ornamental foliage plants because of their peculiar symmetry, grace of structure and an astonishing array of morphological variations, and there has been an increasing demand for them as house plants. Though many of the ferns are highly ornamental, hardly a dozen of them are known to horticulture in India, which otherwise has one of the richest fern floras with about 170 genera and over 800 species reported so far. The only source of information on the Indian fern flora was Beddome's "Handbook to Ferns of British India" till the early part of this century, when C.B.Clarke and C.W. Hope described "Ferns of Northern India" and "Ferns of North-West India", respectively. But the Taxonomy and Nomenclature of ferns had undergone such radical changes that it was considered necessary to study the taxonomy and nomenclature of the Indian Filicineae, their morphology, ecology and distribution and possibilities of cultivation especially when the country is very rich in its fern flora. Morphological and taxonomic investigations on India ferns were, therefore, started at the NBG several years ago, with the objectives of studying the occurrence and distribution of ferns in the country, preparation of detailed illustrated descriptions with keys for identification of Indian species, and observing the salient morphological and anatomical features in sporophytes and gametophytes, particularly, the organization of the stelar system, spore morphology, spore germination, prothallial development, etc. These studies cover over 60 genera and 300 species of the majority of the groups of the homosporous ferns -- Pleopeltoid, Gymnogrammoid, Polystichoid, Thelypteroid, Lomoriopsidoid, Blechnoid, Davallioid, Polypodioid, etc., -- and are reviewed below:

1.1.1 Spore Morphology

Spore morphology of about 1000 species, mostly Indian, constituting all the major groups of ferns has been studied, with a view to make the sporae dispersae of geological deposits and air borne

spores easily and more specifically identifiable. Two types of spores-tetrahedral and bilateral -- occur among the homosporous ferns. Tetrahedral spores, in general, characterize the families Ophioglossaceae, Osmundaceae, Gleicheniaceae, Plagiogyriaceae, Dicksoniaceae, Cyatheaceae, Dennstaedtiaceae, Pteridaceae, Adiantaceae and Parkeriaceae whereas bilateral spores are found in the families Polypodiaceae, Thelypteridaceae, Davalliaceae, Oleandraceae, Aspleniaceae, Blechnaceae, Lomariopsidaceae and Aspidiaceae; families Marattiaceae, Schizaeaceae, Hypolepidaceae, Lindsaeaceae, Vittariaceae and Grammitidaceae have both the types of spores. Bilateral spores mixed with tetrahedral ones are found to occur in many Pteris species (Pteridaceae) in cultivation while tetrahedral spores mixed with bilateral ones have been observed in Lastrea ciliata. A phylogenetic evolution of ferns in relation to the spore morphology and evolutionary trends among various spores types have also been suggested.

1.1.2 Spore Germination

While studying spore germination in different families of the homosporous ferns, importance of polarity in germination has been stressed and on the basis of the planes of cell divisions in relation to the polarity of spore and direction of growth of the first rhizoid and the prothallus, three distinct categories of spore germination have been recognized:- Polar, Equatorial and Amorphous. Three different types of Polar - and six of Equatorial-germination have also been described. While Polar and Equatorial germinations follow distinct patterns of cell-division, the Amorphous germination, which is rare, exhibits neither polarity of cell divisions, nor direction of growth.

1.1.3 Prothallial Morphology and Development

Studies on the prothallus of the homosporous ferns have shown that five types of prothalli occur in the Filicineae; these are Tuberous, Filamentous, Cordate-thalloid, Strap-like and Ribbon-like. Of these the Cordate-thalloid is the most common and all the

other types are rather rare and restricted to certain specific taxa. More common among these is the Ribbon like type found in the families Loxogrammaceae, Vittariaceae, Polypodiaceae and Hymenophyllum group of the Hymenophyllaceae. Strap-like type is intermediate between the Cordate-thalloid type and the Ribbon-like type and has been found in the Grammitidaceae, some Lomariopsidaceae and Polypodiaceae. The Tuberous and Filamentous types of prothalli are perennial and are rare among ferns, the former restricted to the Ophioglossaceae, Actinostachys and Lophidium (Schizaeaceae) and Stromatopteris (Gleicheniaceae) and the latter to Schizaea and trichomanoid genera of Hymenophyllaceae. Prothallial trichomes have got an importance of their own as their morphological features are specific for certain specific families, groups or genera.

The prothallus of homosporous ferns shows a definite pattern of development, leading ultimately to the characteristic adult form. Seven different patterns of prothallial development are recognized, viz., Adiantum-, Aspidium-, Ceratopteris-, Drynaria-, Kaulinia -, Marattia- and Osmunda - types, each differing from the other in the sequence of cell divisions during development, stage of development, and the region at which the meristematic cell or pluricellular meristem is established.

1.1.4 Vascular Organisation

Vascular organization in the rhizome of about 55 genera constituting over 200 species, has been studied. On the basis of these studies, the more primitive condition in the rhizome of the Filicopsida is supposed to be an erect, short rhizome, bearing crowded, spirally arranged leaves. Elongation of such a rhizome, while maintaining the erect position, lead to the dendroid habit as found in the modern Cyatheaceae. The elongated, creeping rhizome has also evolved from the primitive short, erect, condition.

Protostelic vascular cylinder is supposed to be the most primitive from which has developed a hollow vascular cylinder. The

vascular cylinder of the fern rhizome is conceived as a series of lea trace bundles united together by their margins in a definite order.

1.1.5 Taxonomy

The fundamental basis of an understanding of any group of plants is a reliable system of classification, which, as currently understood, is a taxonomic treatment that expresses also phylogeny, and takes in to consideration morphological feature, no matter how small and apparently insignificant it appears. Based on the spore morphology, prothallial morphology, morphological and anatomical characters of the sporophyte, including chromosome counts, a classification of homosporous ferns has been proposed wherein the Filicopsida has been classified into three subclasses - Ophioglossidae, Marattiidae and Filicidae, each having a major line of specialization. A single family Ophioglossaceae constitutes the Ophioglossidae, whereas four families Angiopteridaceae, Danaeaceae, Kaulfussiaceae and Marattiaceae constitute the Marattiidae; the third subclass Filicidae consists of 31 families, three of which, namely, Dryopteridaceae, Cyatheaceae and Polypodiaceae, include five sub families each.

1.1.6 New Species

The taxonomic studies on ferns have also resulted in setting up six new species - Adiantum capillus veneris var. dissecta Nayar, Bolbitis canarensis Nayar and Chandra, B. semicordata var. incisa Nayar and Chandra, Egenolfia keralensis Nayar and Kaur, Microlepia baflangensis Nayar and Kaur, Pyrrosia nayariana Ching and Chandra, and one genus - Kaulinia Nayar. In addition, the genus Peranema has been amended as Peranema Dond emend. Nayar and Kaur. Monographic studies on 20 genera have also been made.

1.1.7 Nomenclature

A companion to Beddome's Handbook to the Ferns of British India, updating the nomenclature used in the latter and removing some of the taxonomic confusions has been brought out; about 20 new combinations of names have also been proposed.

1.1.8 Domestication of Ferns

Domestication of those fern species, which hold promise for cultivation as ornamentals, and formulation of procedures for their ecological adaptation and horticultural practices has been taken up recently. Ferns were collected from various parts of the country, especially North Eastern Himalayas (plains and foothills of Assam and West Bengal) and South India (Nilgiri Hills and Western Ghats) and efforts were made to acclimatize them to Lucknow. Many of these ferns (about 70 species) could successfully be grown by providing conditions, as far as possible, similar to those available in nature; notable among these are species of Adiantum, Pteris, Nephrolepis, Microsorium, Cyrtomium, Selaginella, Anemia rotundifolia, Bolbitis heteroclita, Ceratopteris thalictroides, Doryopteris ludens, Lygodium flexuosum, Drynaria quercifolia and Diplazium esculentum. About a score of the acclimatized species have been propagated on a large scale and grown in pots and baskets. These have become extremely popular in public. Some of the ferns suitable for hanging baskets have also been acclimatized.

1.2 JOINT BOTANICAL EXPEDITION TO TAWANG (ARUNACHAL PRADESH)

At the request of the Government of Arunachal Pradesh, three CSIR laboratories -- RRL, Jorhat, NBG, Lucknow and RRL, Jammu -- and the Botanical Survey of India, Eastern Circle, organised a joint Botanical Expedition to Tawang, Arunachal Pradesh, during Aug. 12 - Sept. 3, 1976. Dr. D. Ganguli, Scientist F, RRL, Jorhat and Miss Niru Nanda, I.A.S., Additional Deputy Commissioner, Tawang acted as Joint Coordinators of the Expedition.

The main objectives of the expedition were to survey the economic flora of the region, to study the occurrence and availability in bulk and the market of the known economic plants of the area and to suggest measures for setting up small scale industries based on these plants. In addition, the expedition was charged with the responsibility of assessing the availability of lemongrass, orchids, edible mushrooms and medicinal plants used in tribal medicine as well

as exploring the prospects of growing saffron in the region.

During its tour, the expedition surveyed the areas of Tawang, Zimithang, Bumla Pass, Jang, Zelerda, Sela Pass, Nooranang, Broxar, Rho Basti, Ani Gounpa near Jangda Basti, Sheyro Basti and Bumla.

Dr. Prakash Chandra and Dr. Mohinder Pal, Scientists and Mr. Ram Adharey, Plant Propagator represented the NBG on the expedition.

1.3 CULTIVATION OF DIOSCOREA FLORIBUNDA

A cultivation trial of Dioscorea floribunda has been conducted at the National Botanic Gardens, Lucknow. This trial, based on growth of Dioscorea tubers for one year, has shown that when the initial tuber weight is around 80gms., the multiplication factor is about 8 in a year and the average tuber yield is nearly 700 gms. The highest tuber yield obtained in this experiment is 1.710 kg. per plant and the highest diosgenin percentage (on dry weight basis) obtained is 4.55. The high yielding clones have been selected for further rapid multiplication. It appears that given the suitable agro-techniques, Dioscorea floribunda may be a profitable crop for this region. This finding is contrary to the reports from Jammu and Delhi where the growth of Dioscorea floribunda has been reported to be very poor (Dioscorea Improvement Project Status Report, Indian Institute of Horticultural Research, Bangalore, 1975).

2. PUBLICATIONS

2.1 RESEARCH PAPERS PUBLISHED

2.1.1 Arora, O.P. -- Differential response of Verbena species to colchitetraploidy. The Nucleus, 1975, 18: 166-71.

2.1.2 Chandra, V., and Gupta, M.N. -- Effects of gamma irradiation on Cymbopogon winterianus Jowitt. I.D.M.A. Bulletin, 1976, 7(25): 364-66.

2.1.3 Gupta, M.N. -- Mutation breeding of peppermint (Mentha piperita Linn.). I.D.M.A. Bulletin, 1976, 7(26): 370-77.

2.1.4 Khanna, K.R. -- Generalized distance (D^2) among Himalayan populations of Gymnostomum. Rev. Bryol. et Lichenol., 1976, 42(2): 683-91.

2.1.5 Khanna, K.R. -- Concepts and recent advances in mathematical genetics with particular reference to plants. Recent Advances in Botany, ed. P. Kachroo. Published by Bishan Singh Mohinderpal Singh, Dehra Dun. India, 1976, 275-89.

2.1.6 Khoshoo, T.N. -- Patterns of evolution and centres of origin of ornamentals. Sci. Cult., 1976, 42: 191-93.

2.1.7 Khoshoo, T.N. and Guha, I. (Nee' Mukherjee) -- Origin and evolution of cultivated cannas. Glimpses in Plant Research, ed. P.K.K. Nair. Published by Vikas Publishing House Pvt. Ltd., New Delhi. 1976, 3: 1-81.

2.1.8 Madhusoodanah, K.J. -- Hybridization between Amaranthus graecizans and A. viridis. Curr. Sci., 1976, 45(19): 703-704.

2.1.9 Narain, P. -- Summary -- Hybridization and polyploidy in relation to Amaryllis species and cultivars. Plant Life, 1974, 30: 94-96.

2.1.10 Narain, P. and Raina, S.N. -- Cytological Assay of C-mitotic potency of colchicine obtained from Gloriosa superba L. Cytologia , 1975, 40: 751-57.

2.1.11 Singh, H.B. and Bhatnagar, Abha -- Chromosome number in an Okra from Ghana. Indian J. Genet., 1976, 36: 26-28.

2.1.12 Singh, U.P. and Khanna, K.R. -- Exploitation of heterosis and gene action in Opium poppy (Papaver somniferum L.). I.D.M.A. Bulletin, 1976, 7(16): 183-85.

2.1.13 Zadoo, S.N., Roy, R.P. and Khoshoo, T.N. -- Cytogenetics of cultivated bougainvilleas-I. Morphological variations. Proc. Indian natn. Sci. Acad., 1975, 41B: 121-32.

2.1.14 Zadoo, S.N.,Roy, R.P. and Khoshoo, T.N. -- Cytogenetics of cultivated bougainvilleas-II. Pollination mechanism and breeding system. Proc. Indian natn. Sci. Acad., 1975, 41B: 498-502.

2.1.15 Zadoo, S.N., Roy, R.P. and Khoshoo, T.N. -- Cytogenetics of cultivated bougainvilleas-V. Induced tetraploidy and restoration of fertility in sterile cultivars. Euphytica, 1975, 24: 517-24.

2.1.16 Zadoo, S.N., Roy, R.P. and Khoshoo, T.N. -- Cytogenetics of cultivated bougainvilleas-VI. Hybridization. Z.Pflanzenz, 1975, 75: 114-37.

2.2 RESEARCH PAPER PRESENTED AT SEMINAR

2.2.1 Narain, P. -- Abstract -- An Interchange Heterozygote in garden Hemerocallis. Sec. all India Congr. Cytol. Genet., held at Udaipur, Oct. 20-24, 1975.

2.3 POPULAR ARTICLE PUBLISHED

2.3.1 Narain, P. -- Buck-wheat -- a potential crop for Uttar Pradesh. Indian Farming, 1976, 26(3): 17-18.

3. Ph.D. DEGREE AWARDED

3.1 "Pollen morphology of Rosaceous fruit plants and their wild allies". Kanpur University, Kanpur -- Mrs. Prem Kumari Singh (Department of Botany, D.G. College, Kanpur).

4. LECTURES, SEMINARS AND SYMPOSIA

4.1 LECTURES

4.1.1 "Project planning, implementation and monitoring systems" -- Mr. S.M. Lal, Scientist, NBG. Aug.31,1976.

4.1.2 "Smithsonian programme on endangered plant species" -- Dr. Edward S. Ayensu, Director, Endangered Species Programme, National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A. ... Sept.22,1976.

4.2 DEPARTMENTAL SEMINARS

4.2.1 "Pigment systems in plants with particular reference to biochemical analysis of bud sports in some Bougainvillea cultivars" -- Mr. Deepak Ohri ... ... July 29,1976.

4.2.2 "Gladiolus cultivation" -- Mr.J.C. Bhutani Aug. 2, 1976.

4.2.3 "Effects of physical mutagens on vegetatively propagated plants" -- Mr. B.K. Banerji ... ... Sept.23,1976.

4.3 SYMPOSIA AND SEMINAR ATTENDED

4.3.1 Dr. T.N. Khoshoo, Director, NBG, attended the Indo-Soviet Symposium on "Genetics and Selection of Cultivated Plants", held at Baku, U.S.S.R. ... ... June 27 - July 8, 1976.

4.3.2 Dr. T.N. Khoshoo, Director, NBG, attended as CSIR observer, the UNESCO Seminar-cum-Workshop on "Management of R & D Institutions", held at Bangalore ... Aug.1-10, 1976.

4.3.3 Mr. S.M. Lal, Scientist, attended the Seminar on "Project Planning, Implementation and Monitoring Systems", organised by the Indian Society for Training and Development, held at Srinagar ... July 11-23, 1976

5. TRAINING, CONSULTANCY AND TECH.ASSISTANCE

5.1 TRAINING

5.1.1 Training Imparted

5.1.1.1 As in the past two years, a training course in "Modern Techniques of Chrysanthemum Culture", was organised from July 21 - 31, 1976, which was attended by 40-trainees.

5.1.1.2 Mr. D. Kameshwar Rao, Chemist, Essential Oil Division, Messrs Rohtak and Hissar Districts Electric Supply Co., Allahabad and Mrs. Usha Dixit, Lucknow, were trained in Production of Menthol from Mentha Oil, during Aug.17 - Sept.14, 1976 and Sept.3 - 30, 1976, respectively.

5.2 CONSULTANCY

5.2.1 Advice on garden layout was provided to the Narendra Dev University of Agriculture and Technology, Faizabad and Jal Nigam, Lucknow.

5.3 TECHNICAL ASSISTANCE

5.3.1 Ten samples of Vetiver roots and a sample of Citronella oil were analysed for the Forest Department of U.P. and CIMAP, Lucknow, respectively.

5.3.2 Gamma irradiation facility was provided to the departments of Botany, University of Lucknow and Banaras Hindu University and Department of Agricultural Botany, S.D.J.P.G. College, Azamgarh.

6. PERSONALIA

6.1 DEPUTATION ABROAD

6.1.1 Dr. T.N. Khoshoo, Director, NBG, deputed to USSR from June 27 - July 8, 1976, under the "Indo-Soviet Collaboration Programme in Scientific Fields", to attend the Indo-Soviet Symposium on "Genetics and Selection of Cultivated Plants", held at Baku, U.S.S.R.

6.2 APPOINTMENT

6.2.1 Mr. P.N. Khanna, Stores Supervisor, appointed on promotion as Stores Officer, w.e.f. 12.7. 1976

6.3 PROMOTIONS

6.3.1	Dr. L.D. Kapoor, Scientist E-I to Scientist E-II w.e.f.	17.12.1975
6.3.2	Mr. V. Chandra, Sci.C to Sci.E-I, w.e.f.	1.4. 1975
6.3.3	Mr. G.S. Srivastava, Sci.C to Sci.E-I, w.e.f.	1.9. 1976
6.3.4	Dr. P.N. Saxena, Sci.B to Sci.C, w.e.f.	12.4.1976
6.3.5	Mr. R.N. Ghosh, Sci.B to Sci.C, w.e.f.	12.4.1976
6.3.6	Mr. Ajai Singh, Sci.B to Sci.C, w.e.f.	19.5.1976
6.3.7	Dr. Gopal Misra, Sci.B to Sci.C, w.e.f.	19.5.1976
6.3.8	Dr. Prakash Chandra, Sci.B to Sci.C, w.e.f.	31.7.1976
6.3.9	Dr. K.J. Ahmed, Sci.B to Sci.C, w.e.f.	31.7.1976
6.3.10	Dr. P.S. Misra, Sci.A to Sci.B, w.e.f.	1.8.1972
6.3.11	Dr.(Mrs.) Aruna Pal, Sci.A to Sci.B, w.e.f.	1.6.1975
6.3.12	Mr. Basant Singh, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.13	Dr. O.P. Arora, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.14	Mr. K.N. Singh, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.15	Mr. V.B. Singh, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.16	Mr. S.M.H. Abidi, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.17	Mrs. Harbans Kaur, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.18	Dr.(Mrs.) Santha Devi, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.19	Mr. Subhash Chandra, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.20	Mrs. Saroj Chandra, S.S.A. to Sci. A, w.e.f.	24.2.1976

6.3.21	Mr. J.C. Bhutani, S.S.A. to Sci.A, w.e.f.	24.2.1976
6.3.22	Mr. L.D. Deo, S.T.A. to Sci.A-1, w.e.f.	24.2.1976
6.3.23	Mr. Sami Uddin, S.T.A. to Sci.A-1, w.e.f.	24.2.1976
6.3.24	Mrs. F. Raza, S.T.A. to Sci.A-1, w.e.f.	24.2.1976

6.4 RETIREMENT

6.4.1 Dr. L.D. Kapoor, Sci.E-2, retired w.e.f. 30.9.1976

6.5 RESEARCH FELLOW

6.5.1 Appointment

6.5.1.1 Senior Research Fellows

1.	Miss Gohar Islam w.e.f.	6.9.1976
2.	Mr. K.J. Madhusoodanan w.e.f.	24.9.1976

6.5.1.2 Junior Research Fellows

1.	Mr. M.A. Nazeer w.e.f.	5.7.1976
2.	Mr. Vinod Chandra Dwadash Shreni w.e.f.	28.7.1976

6.5.2 Resignation

6.5.2.1 Mr. Anil Misra, J.R.F. w.e.f. 16.9.1976

6.6 DISTINGUISHED VISITORS

6.6.1	Prof. Y. Nayudamma, Director-General, Council of Scientific & Industrial Research, New Delhi	July 28, 1976
6.6.2	Mr. Manmohan Attavar, Director, Indo-American Hybrid Seeds, Bangalore	Aug.28,1976
6.6.3	Dr. J.C. Verman, President, Forest Research Institute and Colleges, Govt. of India, Dehra Dun ...	Aug.30,1976
6.6.4	His Excellency Dr. M. Channa Reddy, Governor of Uttar Pradesh, Lucknow ...	Sept.1,1976
6.6.5	Dr. G.S. Randhawa, Director, Indian Institute of Horticultural Research Bangalore	Sept.6,1976
6.6.6	Mr. S.M. Krishnatry, Chief Commissioner, Andaman and Nicobar Islands, Port Blair	Sept.7,1976

6.6.7	Prof. T.S. Mahabale, Maharashtra Association for Cultivation of Science, Poona	Sept.16, 1976
6.6.8	Dr. Edward S. Ayensu, Director, Endangered Species Programme, National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A. ...	Sept. 21-23,1976
6.6.9	Dr. C. Kempanna, Assistant Director-General, Indian Council of Agricultural Research, New Delhi	Sept.24, 1976
6.6.10	Mr. G.C. Mathur, Acting Chief Justice, U.P. High Court, Allahabad	Sept.27, 1976

7. FORTHCOMING EVENTS

7.1	HOUSE PLANTS SHOW ...	OCT.9-10, 1976
7.2	EXHIBITION OF INDIGENOUS HERBAL DRUGS	NOV.20-22, 1976
7.3	ANNUAL CHRYSANTHEMUM AND COLEUS SHOW	DEC. 4 - 5, 1976

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